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ABSTRACT

Different effects of instructional strategies on recall and comprehension of terms frequently used in formal analysis of art were examined. The study looked at a synthesis of three theoretical positions: dual-coding theory, schema theory, and elaboration theory. Two-hundred and fifty sixth-grade students were randomly assigned to three groups: control subjects, graphic subjects, and transformational subjects. Instruments consisted of Raven's Standard Progressive Matrices (RSPM) and the Art Vocabulary Test (AVT). The program consisted of three phases: (1) a 10-minute study session; (2) an interactive discussion, and (3) a drawing task. The results suggested that imagery strategies help students form and retain associations between verbal and visual information. Graphic organizers may promote more flexible applications of the associations for individuals who have already acquired good problem-solving skills. The concrete associations obtained from transformational imagery strategies improve student recall of specific associations. However, interview data suggested that the approach may constrain the associated meaning. Trends in the data are consistent with elaboration theory and could inform scholars and researchers who wish to analyze effects of visual and verbal associations. (KM)

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EFFECTS OF VISUAL/VERBAL ASSOCIATIONS

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EFFECTS OF VISUAL AND VERBAL ASSOCIATIONS

Over the last two decades, researchers in the related fields of art, education and psychology have contributed substantially to the knowledge base on the effects of associations of verbal with visual information. The research has supported theories to explain processes that may underlie these effects (Kosslyn, 1980, Paivio, 1971, 1986; Rowher, 1980, Rumelhart, 1980). This theoretical base provided a framework for predicting specific effects of combinations of visual and verbal information. Scholars, researchers, and teachers could benefit from research-based information concerning the cognitive effects of different types of verbal and imaginal combinations.

This paper reports partial results from a larger experiment concerned with effects of instructional strategies using visual and verbal associations. The controlled, quasi-experiment examined differential effects of two such strategies on recall and comprehension of terms often used in formal analysis of art.

Theoretical Base

Contemporary learning theory (Shuell, 1986) encompassed many informal theoretical positions that explained specific phenomena or processes. Several of these theories proposed to explain observed effects of pictures and visual materials. One of the earliest and most prominent of these was dual doding theory (Paivio, 1971, 1986). Dual coding theory evolved from early paired-associate learning research (Paivio, 1963) and was frequently modified, clarified, or refined in response to new research findings (Paivio, 1986; Paivio, Clark, & Khan, 1988). Dual coding theory suggested that language and visual perception were served by separate, parallel symbolic systems, with each system differentially specialized. Paivio's theory was frequently cited in research, particularly studies examining the effects of context and related pictures on verbal learning.

Kosslyn (1980) described dual coding theory as simplistic, arnd argued that specialized neuron groups probably served the language and visual perceptual systems. Day and Bellezza (1983) argued that schema theory (Rumelhart, 1980) was more consistent with data on imagery in associate learning than dual coding theory. Schemata for thematic associations, according to Day and Bellezza (1983), explained subjects' differential recall for abstract versus concrete nouns. Paivio (1986) argued that dual coding theory offered a parsimonious explanation for differences in recall without the necessity for hypothetical structures proposed by schema theory. Elaboration theory (Rowher, 1980) offered yet another cogent explanation for the documented effects of visual/verbal associations. Mayer (1989) suggested that spatial qualities of graphics could promote systematic thinking in novices, resulting in improved conceptual understanding of complex relationships. Each theory offered a useful, but incomplete, explanation for observed effects of visual and verbal associations. The present study contributes toward the continuing synthesis of these theoretical positions.

Methodology

The results reported here were obtained as part of a larger study conducted in a classroom environment in a large urban school district in the southwest. The research design consisted of a multi-method single factor quasi-experiment (Campbell and Stanley, 1963). Participating teachers were selected from the pool of middle school art teachers who had volunteered in order to provide a sample of sixth grade art students similar to the population in the school district as a whole. Over the course of the study, the initial sample of 250 sixth grade students was reduced to 190 students due to attrition. At the beginning of the study, participating students at each school were randomly assigned to three groups.

At the end of the study, groups consisted of 66 control subjects, 62 graphic subjects, and 62 transformational subjects.

Instruments consisted of the Raven's Standard Progressive Matrices (RSPM) (Raven, Court, & Raven, 1983) and the Art Vocabulary Test (AVT). The RSPM was used to predict general problem-solving abilities. The Art Vocabulary Test was a treatment specific test developed for the present study. Both tests were found to be highly reliable and internally consistent. The sample distribution for the RSPM was similar to the distribution for similar samples (Raven, 1986). The Correlation of the RSPM and the AVT was .56 for the pretest and .46 for the posttest.

Treatment consisted of three phases: (a) a ten-minute study session, (b) interactive discussion, and (c) a drawing task. Treatments varied only in the type of assigned visual study strategies. Graphic students received definitions illustrated by several representations, varying in content and level of abstraction. The theoretical basis for graphic organizers was proposed by Mayer (1989). Transformational students received the same definitions, accompanied by illustrations conforming to guidelines for associative learning proposed by Levin (Levin, Anglin, & Carney, 1987).). A two (ability) by three (treatment) analysis of covariance was conducted to compare treatment-group means for high-ability and low-ability students on the Art Vocabulary Test posttest, statistically controlling for the pretest.

The analysis of covariance tested two null hypotheses:

(1) $H_o : X_1 = X_2 = X_3$

and the interaction,

(2) $H_o : X_{(1,3)} * Ab_1 = X_{(1,3)} * Ab_2$

The alpha for the design was set at .05. The rationale for this selection was that this alpha was sufficiently liberal to identify actual differences in the sample, and still allow conservative post hoc analyses of differences among treatments and ability levels. Random student interviews, conducted two to four weeks following treatment, investigated students' understanding of the concepts presented during treatment.

Results

The results of the analysis of covariance indicated that the means for the three groups differed, F (2, 183) = 7.51, p < .001, leading to rejection of the null hypothesis of no difference among treatment groups on the Art Vocabulary posttest, statistically controlling for the pretest. The interaction of treatment and ability was not statistically significant. Since the interaction was not significant, no post hoc tests were performed for the interaction. Observed means and standard deviations, and adjusted means are reported in Table 1.

Table 1

Observed AVT Pretest and Posttest Means by Treatment

		AVT Pre		AVT Post	
Treatment	N	Mean	SD	Mean	SD
Control	66	6.06	5.94	12.41	7.75
Graphic	62	6.31	5.66	16.42	9.37
Trans	62	6.34	6.78	17.50	9.81
All	190	6.23	6.11	15.38	9.22

In order to identify the source of the difference among the three means, adjusted posttest means were compared using a Sheffe test. The Sheffe procedure was selected

because it is a conservative test that allowed comparisons of all possible combinations of means and because it is robust to deviations from a normal distribution (McNemar, 1969). The Sheffe method requires computation of a value, K, to determine the critical value of the F ratio for the level of significance and (j - 1), (N - j - 1) degrees of freedom. The F value for each comparison must exceed this critical value, K, in order to reject the null hypothesis of no difference in group means. In this formula, N is the total sample size and j is the number of groups in the analysis. With $df = 2, 186$, $\alpha = .05$, a table F value of 3.00 is found.

For the present analysis:

$$K = (2 * 3.00)) = 2.45$$

The adjusted within groups mean squares was computed using the MANOVA program from the SPSS-X statistical package (SPSS, 1985). The adjusted mean squares (within) for the total sample in the comparison was found to equal 53.42. The adjusted mean squares (within groups) is used to compute the sampling error variance. The Sheffe procedure then compares variances of the difference between groups to the variance within groups for each possible combination of adjusted treatment group means:

$$F = \frac{X_1 - X_2}{MS_w^2 [(1/N_1) + (1/N_2)]}$$

1. Adjusted transformational group mean with adjusted control group mean:

$F = (17.43 - 12.53) / [53.42 * (1/62+1/66)] = 2.95$

2. Adjusted treatment group mean with adjusted control group mean:

$F = (16.37 - 12.53) / [53.42 * (1/62 + 1/66)] = 2.45$

3. Combined treatment group mean with control group mean:

$F = (17.43 - 16.37) / [53.42 * (1/62 + 1/62)] = .62$

For the comparison of transformational group students' adjusted mean AVT posttest score with control students' adjusted mean AVT posttest score, the F statistic exceeded the critical K value of 2.45, (F 2, 186 = 2.95). Because the value of F for this contrast exceeded the critical value, the hypothesis of no difference between the two means was rejected at the .05 level of significance. For the comparison of graphic group students' adjusted mean AVT posttest score with control students' adjusted mean AVT posttest score, the F statistic was equal to or greater than the control group students' adjusted mean AVT posttest score, leading to the rejection of the null hypothesis of no difference in means at the .05 level of significance. The difference in adjusted means for the two groups was not statistically significant. Since the analysis of covariance failed to identify a significant interaction of treatment and ability, no tests were conducted to compare differences in means by treatment and ability.Table 2 reports observed and adjusted posttest means for high-ability and low-ability students in the three treatment groups.

Table 2.

Adjusted AVT Posttest Means for High-Ability and Low-Ability Students by Treatment

	Low	High	Total
Control	10.30	13.10	12.53
Graphic	12.74	18.14	16.37
Trans	15.95	17.70	17.43

Effect Size

Effect sizes were computed to allow comparison of effects of treatment with percentile differences of the expected scores for students in the three treatment groups. Effect size (Δ) allows comparison of effects of different treatments and provides a means to estimate the differences in percentile rank that may be attributed to treatment. Effect sizes were computed by dividing the difference between adjusted treatment and control means by the square root of the within group mean sum of squares. Since effect size is a descriptive statistic, reports are not limited to significant differences alone. Relative differences can be compared by subtracting effect size for different cells in the analysis.

The effect size for the graphic treatment was:

$$\Delta = (16.37 - 12.53) / 53.42 = .53$$

In terms of percentage scores, the mean score for students in the graphic treatment group was at the 70th percentile score for control group students.

The effect size for the transformational treatment was:

$$\Delta = (17.41 - 12.53) / 53.42 = .65$$

In terms of percentage scores, the mean score for students in the transformational treatment group was at the 74th percentile score for control group students.

The effect size between treatments was:

$$\Delta = (17.41 - 16.36) / 53.42 = .14$$

The mean score for transformational group students was at the 56th percentile score for graphic group students.

Analysis of Art Vocabulary Test Scales

The Art Vocabulary Test was comprised of four scales, with each scale requiring a different type of application. This difference in the scales suggested the possibility that the

three treatments would have differential effects for results on the four scales. Table 3 reports adjusted means for the three treatment groups on each of the scales.

Table 3

Adjusted AVT Scale Means for High-Ability and Low-Ability Students by Treatment

		Control	Graphic	Trans
Prod	Low	2.69	3.64	4.67
	High	4.01	5.22	5.27
Recall	Low	2.27	2.89	3.68
	High	2.85	4.04	3.74
Match	Low	2.72	3.30	3.94
	High	3.15	4.37	4.41
Draw	Low	2.61	2.90	3.65
	High	3.08	4.50	4.28

The adjusted scale means suggested possible differential effects of treatment for high-ability and low-ability students.

Random followup interviews were conducted two to four weeks following the conclusion of treatment. The descriptive analysis of interview cases indicated that, of the students who were interviewed, students in the graphic group experienced more success in concept definition and use than did control or transformational students. Although graphic students were more often successful, they reported using imaging strategies less often than did transformational students. These students more often reported that they recalled information from sources independent of the study. Math or science classes, music and

television were cited most frequently. Transformational students recalled specific images from the study materials more often than either graphic or control students. In the interviews, which were conducted several weeks subsequent to treatment, subjects often made reference to the specific images that had been presented: "motion....like a car, going fast"; but these same subjects failed to recall when or how they had encoded the image.

Conclusions

Imagery effects have interested scholars in the arts and sciences since the time of St. Augustine. However, controlled, experimental emprical research in this area is relatively recent. The present study contributes information about differential effects of specific types of imagery. Results reported here suggest that imagery strategies help students form and retain associations between verbal and visual information. Graphic organizers may promote more flexible applications of the associations for individuals who have already acquired good problem-solving skills. The concrete associations obtained from transformational imagery strategies improve student recall of specific associations. However, interview data suggested that the approach may constrain the associated meaning. Trends in the data are consistent with elaboration theory (Rowher, 1980) and could inform scholars and researchers who wish to analyze effects visual and verbal associations. Further research is needed to examine the effects of visual/verbal associations in various environmental contexts.

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